HOPI COTTON, A VARIABLE SPECIES [1]

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INTRODUCTION

There is much interest at present in Hopi cotton (*Gossypium hopi* Lewton), a species formerly cultivated by the Hopi Indians of northeastern Arizona on the Hopi Indian Reservation. This interest, stimulated by tests conducted by the Bureau of Agricultural Economics of the United States Department of Agriculture,[2] has resulted in requests for seed from cotton breeders in this and foreign countries, who hope to combine the spinning qualities of the aboriginal cotton with the productivity of commercial varieties. Archeologists are interested in Hopi cotton on account of its probable identity with the fiber found in prehistoric ruins in the Southwest.[3]

BREEDING STOCK

The behavior of several strains of *Gossypium hopi* in the breeding plots at the United States Field Station, Sacaton, Ariz., indicates that the species is genetically heterozygous and capable of modification by selection. Until 1933 only two strains were grown at Sacaton. One of these, "Moqui," is an inbred descendant of seed collected in 1911 at Oraibi Village, on the Hopi Indian Reservation, by Frank A. Thackery.[4] The other, "Sacaton Aboriginal", descended from seed obtained from a Pima Indian at Sacaton, on the Gila River Indian Reservation. It was assumed to be the kind of cotton grown by the Pimas before the advent of the white man. As grown at Sacaton, the plants of both strains are erect, 5 to 8 feet high, and have pitted bolls and yellow pollen. They differ in these characters from Lewton's description and illustrations of *G. hopi*.

In 1932 C. J. King and George J. Harrison, of the United States Department of Agriculture, obtained seed cotton from an old Hopi Indian at Moencopi, on the Hopi Indian Reservation, Ariz., who told them that he was growing his third successive crop for ceremonial purposes. Replies to previous inquiries about the production of cotton on the Indian reservations had indicated that none had been grown for a number of years.

In 1933 several hundred hills of cotton from this new supply of seed, designated "Hopi Moencopi" or "Hopi M," were grown at Sacaton. Approximately 40 plants were selected for propagation, several of which showed different degrees of pitting of the surface of

[1] Received for publication July 9, 1937; issued April 1938.

[2] ANONYMOUS. NEW FACTS ON STRENGTH OF COTTON START BREEDING FOR FINE SHORT STAPLE. Mid-South Cotton News 13 (11): 8. 1936.

CATES, J. S. NEW STAPLE BREEDING TARGET. Country Gent. 106 (9): 21, 84–85, illus. 1936.

[3] JONES, V. H. A SUMMARY OF DATA ON ABORIGINAL COTTON OF THE SOUTHWEST. N. Mex. Univ. Bull. 296 (Anthropological Ser. v. 1, no. 5): 51–64. 1936.

[4] LEWTON, F. L. THE COTTON OF THE HOPI INDIANS; A NEW SPECIES OF GOSSYPIUM. Smithsn. Misc. Collect. 60, no. 6, Pub. 2146, 10 pp., illus. 1912. (See p. 7.)

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the bolls. The progenies grown in 1934 from self-pollinated seed continued to show segregation in respect to boll surface, and further selections were made. In addition, plants with white corollas, and others with cream-colored pollen, were observed and selected. From these selections, progenies have been isolated that breed true for white corolla, yellow corolla, cream-colored pollen, yellow pollen, smooth boll surface (oil glands embedded and confined to an area near the sutures), and pitted boll surface. Figure 1 shows the range of pitting found in bolls of these progenies of the Hopi Moencopi strain.

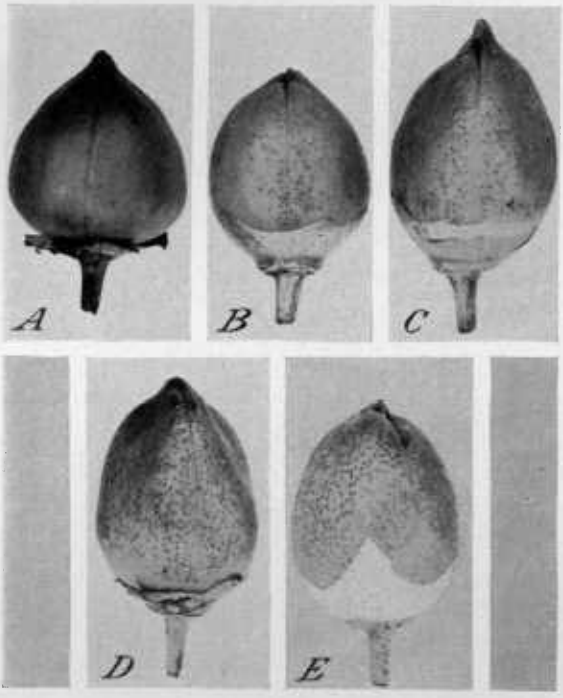

FIGURE 1.—Bolls from five progenies of the Moencopi strain of Hopi cotton showing differences in degree and character of the oil glands. The number of glands increases from none, or almost none, in *A* to numerous in *E*. In *A*, *B*, and *C* the glands, which are only along the sutures, are embedded, whereas in *D* and *E* they are in visible pits on the surface. Natural size.

In 1933 many of the plants exhibited the prostrate habit described by Lewton, having main stalks and limbs that reclined by the time they were 3 months old. In succeeding generations the progenies of plants from which self-pollinated seed was obtained tended to assume a more nearly erect habit. However, none of the plants in the progenies of the Moencopi strain have developed main stalks as strong as those of the Moqui and Sacaton aboriginal strains. This weakness of stems varied from progeny to progeny, being least pronounced in the progenies, grown in 1936, that were designated Hopi M 34–6–2 and M 34–9–2.

COMPARISON OF CHARACTERS

Table 1 presents a comparison of nine characters of the Hopi progenies grown at Sacaton in 1936. The first two progenies listed in the table, Hopi M 5–4–13 and M 5–4–10 (fig. 2), come nearest to matching Lewton's description, having yellow corollas, cream-colored pollen, and smooth boll surface. The next three selections from Hopi Moencopi have yellow instead of cream-colored pollen, and progenies M 34–6–2 and M 34–9–2 further depart from the original description by having the surface of the bolls conspicuously pitted like those of Pima (*Gossypium barbadense* L.). These two progenies approach the two long-inbred strains of Hopi—Moqui and Sacaton aboriginal—in plant habit, in corolla color, and in boll surface, and are the most productive

of the Moencopi strain. The last four progenies introduce another character, white corolla, and have boll surfaces intermediate in degree of pitting.

TABLE 1.—*Comparison of certain characters in progenies of Hopi cotton grown at the United States Field Station, Sacaton, Ariz., in 1936*

Progeny designation	Inbred generations	Corolla color	Pollen color	Boll surface grade [1]	Seed-cotton weight per boll	Seeds per boll	Seed index	Lint index	Lint percentage	Upper quartile fiber length
	No.				*Grams*	*No.*				*Inch*
Hopi M 5-4-13	3	Yellow	Light cream	0.15	1.63	16.1	8.05	2.00	20.0	0.93
Hopi M 5-4-10	3	do	Cream	.30	1.82	18.2	8.10	1.88	18.8	.96
Hopi M 6-10-1	3	do	Yellow	.94	1.26	12.6	7.70	2.26	22.8	.87
Hopi M 34-6-2	3	do	do	4.00	1.36	12.9	8.40	2.22	20.9	.98
Hopi M 34-9-2	3	do	do	4.00	1.40	13.8	7.90	2.18	21.9	.95
Moqui	13	do	do	3.75	1.95	16.5	10.04	1.78	15.2	.83
Sacaton aboriginal	14	do	do	3.75	2.04	20.0	8.62	1.54	15.6	.87
Hopi M 6-3-5	3	White	do	1.16	1.50	11.5	10.76	2.26	17.3	.88
Hopi M 6-14-1	3	do	do	1.96	1.79	15.6	9.00	2.48	21.6	.86
Hopi M 6-16-5	3	do	do	1.11	1.79	13.5	10.40	2.78	21.1	.84
Hopi M 6-16-7	3	do	do	1.34	1.65	13.2	9.98	2.56	20.5	.82

[1] Based on an arbitrary range of 5 grades, 0 to 4, inclusive, illustrated in fig. 1.

The undesirable character of Hopi cotton for commercial production is shown (table 1) by the seed-cotton weight per boll and the lint percentage. For the purpose of comparison, these and associated characters for Hopi and for Acala—the latter being the leading upland cotton variety grown in Arizona—are given in table 2.

TABLE 2.—*Comparison of certain characters in Hopi and Acala cottons*

Character	Hopi [1]	Acala
Seed-cotton weight per boll, grams	1.65	6.18
Seeds per boll, number	14.9	32.5
Seed index	9.0	13.0
Lint index	2.18	7.71
Lint percentage	19.6	36.0

[1] Means of the values for the respective characters listed in table 1.

In order to emphasize the small size of the Hopi bolls, it is computed that 1,403 would be required to furnish 1 pound of lint, as compared with only 204 bolls of the Acala variety. The values for seed index, lint index, and lint percentage show that the seeds of Hopi are not only small but are sparsely covered with lint.

The fiber length given in table 1 is the upper quartile of sorted arrays rather than the mean, as Webb [5] and his associates have found that in ginned cotton fiber the upper quartile length approximates the length determined by professional cotton classers. For fiber length Lewton [6] gives a range of 18 to 25 mm (0.70 to 0.98 inch). The Hopi progenies range from 0.82 to 0.98 of an inch in upper quartile length (table 1), and all of them seem to meet the requirements of the original description in having "white, strong, fine, and silky" lint.[6]

[5] WEBB, R. W. SUTER-WEBB COTTON FIBER DUPLEX SORTER . . . Amer. Soc. Testing Materials Proc. 35, v. 32, pt. 2, pp. 1–11, illus. 1932.

[6] LEWTON, F. L. See footnote 4, particularly p. 10 of reference.

Genetic experiments, involving interspecific crosses, confirm the evidence from morphological characters that *Gossypium hopi* is more closely related to *G. hirsutum* L. than to *G. barbadense*. Segregation in F_2 was much less pronounced in the cross with upland cotton (*G. hirsutum*) than in the cross with Egyptian cotton (*G. barbadense*),

FIGURE 2.—Plants of the Moencopi strain of Hopi cotton, progeny M 5-4-10, 107 days after planting. Note the well-developed fruiting branches. The plants were from 30 to 34 inches high.

and there was much less sterility in *hirsutum* × *hopi* F_2 than in *barbadense* × *hopi* F_2. A study of the behavior of several contrasting characters in intraspecific crosses among different progenies of *G. hopi* is now in progress.

SUMMARY

The data presented in this paper indicate that Hopi cotton, formerly grown by the southwestern Indians, is heterozygous and capable of modification by selection. Progenies have been isolated that breed true for each character of the following allelomorphs: (1) Yellow and white corollas, (2) yellow and cream-colored pollen, and (3) smooth and pitted bolls.